5-1302

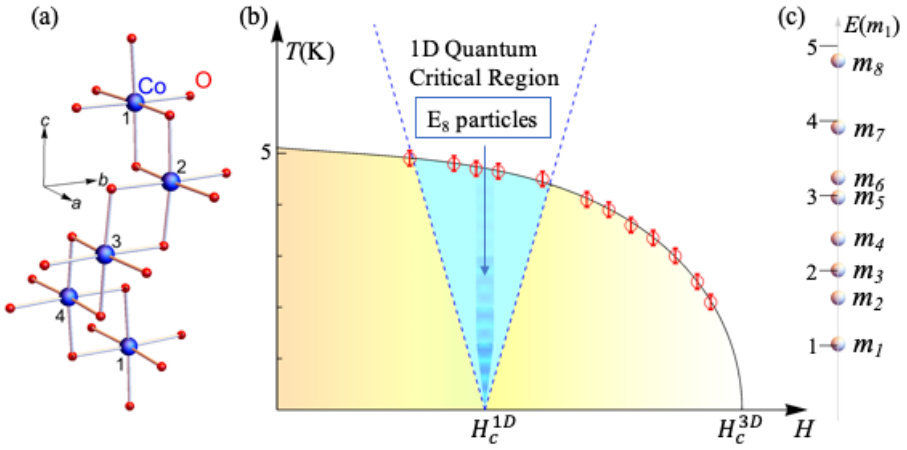
E_8 dynamics in a Perturbed Quantum Critical Ising Chain and its Experimental Realization in $BaCo_2V_2O_8$ Material

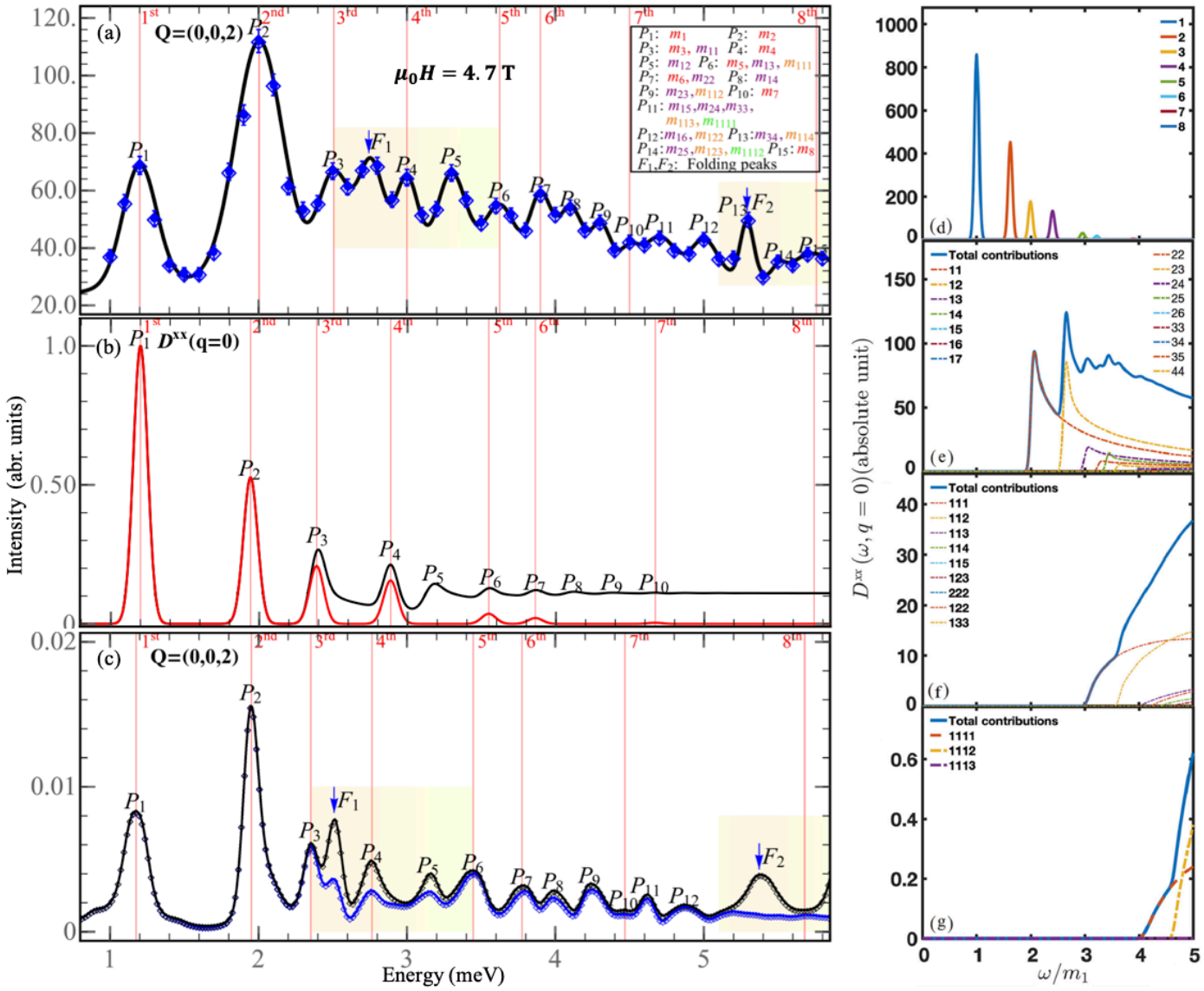
Xiao Wang, Jianda Wu*

Shanghai Jiao Tong University, China

Near-critical system can exhibit exotic excitations. When the quantum critical transverse-field Ising chain is perturbed by a longitudinal field, a quantum integrable model emerges with massive excitations described by the exceptional E_8 Lie algebra. Following analytical form factors of the quantum E_8 integrable model, we systematically study the spin dynamic structure factor of the perturbed quantum critical Ising chain, where particle channels with total energy up to $5m_1$ (m_1 being the mass of the lightest E_8 particle) are exhausted. Besides significant single-particle channels' contribution to the dynamic spectrum, multi-particle channels also exhibit rich features in the continuum region, such as the Van Hove's singularity in two-particle channels with different particles. Since a series of experimental evidence have shown the Ising universality class in the material $BaCo_2V_2O_8$, an unambiguous experimental realization of the massive quantum E_8 integrable model is further observed via nuclear magnetic resonance and inelastic neutron scattering measurements. Under the guidence of theoretical analysis, the large separation between the masked 1D and 3D quantum critical points of the system allows us to identify, for the first time, the full 8 single-particle E_8 excitations as well as various multi-E_8-particle states in the spin excitation spectrum. Our results open new experimental and theoretical route for exploring the dynamics of quantum integrable systems in a concrete material background, and thus bridge key physics in condensed matter and statistical field theory.

References:
[1] Phys. Rev. B 101, 220411(R) (2020).
[2] Phys. Rev. B 103, 235117 (2021).
[3] Phys. Rev. Lett.127, 077201 (2021).





*Corresponding author Jianda Wu

Affiliation Shanghai Jiao Tong University

E-mail address wujd@sjtu.edu.cn